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Plant Height and Yield of Maize-Chickpea Sequence as Influenced by Different Sowing Windows and Nitrogen Management

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ABSTRACT

A field experiment was conducted on clay soils of Regional Agricultural Research Station, Lam, Guntur during *kharif* and *rabi* of 2013-14 & 2014-15 to assess the influence of sowing widows and nitrogen management in maize-chickpea sequence under rainfed areas of Krishna zone. Sowing windows and nitrogen levels significantly influenced the plant height and grain yield at all growth stages of preceding maize and succeeding chickpea except plant height at 30 DAS in preceding maize. Significantly maximum plant height at different growth stages and the highest kernel yield of preceding maize was recorded when maize was sown on the 2nd FN of June with 200 RDN might plant height and grain yield of succeeding chickpea was recorded when succeeding chickpea was sown in the 1st FN of July sowing window of preceding maize with 200 % RDN followed by 100 % RDN applied to chickpea in both the years of the experimentation.

Key words: *Maize-chickpea sequence, recommended dose of N and sowing window.*

Improving and maintaining soil health for enhancing and sustaining agricultural production is of utmost importance for India's food and nutritional security. Due to increase in population pressure, the demand for food, feed, fodder, fiber, fuel, pulses and oil seed production is rapidly increasing. To meet the future demand, we would need better planning and management along with of crop production. One of the alternatives to achieve this goal is to raise the crop productivity through improved varieties and the matching production technologies to sustain soil fertility, cropping systems and crop productivity in future. Intensive cultivation through multiple cropping with proper planning in a sustainable way will help in increasing the food grain production for meeting the future demand and requirement. Maize in *kharif* and chickpea in *rabi* is one of the crop sequence in India in both irrigated and rainfed areas. Maize-chickpea sequence will be profitable than sole in crop and also helps in soil fertility maintenance is a long run is introduced in Krishna zone of Andhra Pradesh. If this crop sequence is introduced to the Krishna agro-climatic zone of Andhra Pradesh, it will be beneficial in many ways. Both the crops together require comparatively shorter period and at the same time risk free with secured income to the farmer and sustainable to the soil health. Therefore introduction of maize-chickpea with intensive input management under rainfed conditions of Krishna zone may sustain the economy of the rainfed farmers of the Krishna zone. The yield of maize and chickpea mainly depends on the major agronomic practices ie., time of sowing and nitrogen sup ply to these crops. The Information on suitable sowing window with appropriate nutrient management on maize-chickpea sequence is meagre in the Krishna agro-climatic zone of Andhra Pradesh. Keeping this in view, the present experiment is proposed

MATERIAL AND METHODS

Field experiment was conducted in 17th block of Regional Agricultural Research Station, Lam Farm located at Guntur (Latitude:$16^{0}18^{1}$, Longitude: $80^{0}29^{1}$, Altitude:33 m.a.m.s.l). The climate is sub-tropical with mean annual rainfall of 950 mm. The soil of experimental field was clay loam in texture, neutral to slightly alkaline in reaction (pH 7.8 to 8.2). The available N, P_2O_5 and K_2O in soil were 204 (low), 96.5 and 886.5 kg ha^{-1} (high), and medium in organic carbon (0.51%) content respectively. The experiment was conducted for two successive *kharif* and *rabi* seasons of 2013-14 & 2014-15 in Krishna agro-climatic zone of Andhra Pradesh. The experiment consisting of three

Table 1. Plant height and yield response of maize at different sowing windows and nitrogen levels under maize-chickpea sequence.

Treatments	Plant height (cm)						Yield kg ha^{-1}	
	30 DAS		60 DAS		Harvest			
	2013	2014	2013	2014	2013	2014	2013	2014
Main Plots:Sowing windows (A)								
2st FN of June	89.33	84.33	220.49	222.28	258.42	224.44	9552.00	9487.00
1nd FN of July	88.82	83.82	214.28	204.28	232.07	212.11	9348.00	9283.00
2st FN of July	85.16	79.58	190.89	181.67	213.91	205.50	7771.00	7706.00
SEm ±	3.74	3.42	8.32	6.39	10.87	4.43	318.94	318.94
CD (0.05)	NS		32.67	25.08	42.68	17.38	1252.31	1252.30
C V %	12.79	12.42	11.89	9.45	13.89	6.12	10.76	10.84
Sub-plots: N Levels (B)								
100 % RDN	82.27	76.69	192.22	188.92	215.44	191.00	8140.00	8075.00
150 % RDN	88.98	83.98	211.99	202.77	231.86	212.93	9135.11	9070.11
200 % RDN	92.07	87.07	225.89	215.53	257.10	238.12	9396.22	9331.22
SEm ±	3.14	3.10	7.45	8.04	11.57	8.78	261.29	261.29
CD (0.05)	NS		22.96	24.79	35.66	27.06	805.11	805.10
C V %	10.72	11.20	10.64	11.90	14.78	12.27	8.82	8.88
Interaction	NS		NS		NS		NS	

sowing windows as main plots treatments viz., 2nd FN of June, 1st FN of July and 2nd FN of July, three nitrogen levels as sub-plot treatments viz., 100 %, 150 % and 200 % RDN to preceding maize and four N levels as sub-sub plot treatments viz., 0, 50 %, 75 % and 100 % RDN to succeeding chickpea. All treatments are randomly allocated in three replications and split plot design for *kharif* season and double split designs for *rabi* crop was adopted for both years of the study. Each main plot (18x12m^2) divided in required size of three sub plots (6x12m^2) and each sub-plot (6x3 m^2) again divided in to four sub-sub plots. Accordingly the treatments were imposed randomly. Recommended dose of N for maize was applied in three splits ($^1/_2$ at sowing, ¼ at knee high stage and ¼ at tasseling stage, respectively) to preceding maize and entire dose at the time sowing to succeeding chickpea. The most popular and non lodging medium duration maize variety ie., P-3396 and popular desi chickpea JG-11 were used in both the year the study. The data pertaining to soil, weather and yield attributes and yield was collected during crop growth period. Statistical analysis for growth and yield parameters were done following the analysis of variance technique for split and double split design respectively as suggested by Gomez and Gomez (1984). Statistical significance was tested by applying F-test at 0.05 level of probability and critical difference (CD) were calculated for those parameters.

RESULTS AND DISCUSSION

Effect of sowing windows and N levels on maize

Growth and grain yield of maize was affected significantly due to sowing windows during both the years of study (Table 1). The maximum plant height at different growth stages and the highest kernel yield was recorded with the crop sown on 2nd FN of June it might be due to favorable climatic conditions that might have resulted in growth promotion by early sowing and have the taller plants. The increased kernel yield in first sowing window might be due to the cumulative effect of substantial improvement in plant height. Efficient metabolic activity due to better soils and environmental factors in the first sowing window might be the reason for the higher kernel yield. This taller and higher yield during early sowing and lower

Table 2. Plant hieght and yield response of chickpea at different sowing windows and nitrogen levels under maize-chickpea sequence.

Treatments	Plant height (cm)						Grain Yield Kg ha $^{-1}$	
	30 DAS		60 DAS		Harvest			
	2013	2014	2013	2014	2013	2014	2013	2014
Main Plots:Sowing windows (A)								
2st FN of June	14.46	13.76	28.72	27.83	40.37	39.43	1335	1325
1nd FN of July	18.02	17.29	42.43	41.53	47.75	46.80	1743	1742
2st FN of July	16.22	15.68	33.99	33.09	45.63	44.68	1550	1539
SEm ±	0.21	0.27	0.40	0.69	0.29	0.49	8.99	12.20
CD (0.05)	0.83	1.10	1.56	2.41	0.96	1.52	27.55	33.52
CV (%)	7.80	10.36	6.81	10.77	3.29	5.32	2.72	3.34
Sub-Plots: Nitrogen Levels (B) applied to maize								
100% RDN	16.00	15.26	33.57	32.67	43.74	42.79	1405	1399
150% RDN	16.19	15.52	35.39	34.39	44.26	43.32	1477	1472
200% RDN	16.51	15.95	36.28	35.38	45.74	44.80	1749	1735
SEm ±	0.11	0.19	0.17	0.36	0.31	0.46	12.53	24.99
CD (0.05)	0.34	0.59	0.52	1.10	0.95	1.41	37.90	76.47
CV (%)	4.01	7.40	2.91	6.24	4.13	6.30	4.80	9.70
Sub-Sub plots: Nitrogen Levels (C) applied chickpea								
0 % RDN	16.01	15.32	33.56	32.66	42.12	41.17	1224	1220
50 % RDN	16.12	15.32	34.51	33.61	43.62	42.67	1462	1448
75 % RDN	16.27	15.56	35.42	34.54	45.56	44.59	1637	1629
100 % RDN	16.54	16.11	36.69	35.79	47.06	46.12	1852	1845
SEm ±	0.16	0.23	0.21	0.36	0.44	0.75	16.59	27.39
CD (0.05)	0.45	0.66	0.60	1.03	1.24	2.15	49.80	82.20
CV (%)	5.04	7.80	3.20	5.54	5.10	9.03	5.90	9.81
Interaction								
AxB	NS	NS	NS	NS	NS	NS	NS	NS
AxC	NS	NS	NS	NS	NS	NS	NS	NS
BxC	NS	NS	NS	NS	NS	NS	NS	NS
AxBxC	NS	NS	NS	NS	NS	NS	NS	NS

yields and dwarf plants at delayed sowings was also reported by the earlier workers like Maryam Jasemi *et al*. (2013).

The three nitrogen levels tried were found significant on growth and kernel yield of maize. Among the three nitrogen levels tried, nitrogen applied at 200 % RDN significantly recorded taller plants and more kernel yield over 100 % RDN but it was on a par with 150 % RDN. It might be due to better availability and utilization of nitrogen resulting in improved assimilation of nitrogen with increasing levels of nitrogen resulting in increased plant height and cell division and cell elongation as promoted by nitrogen. Adequate nitrogen supply increased the amount of cell plama and chlorophyll, which is a factor for growth of the crops. Milthrope and Moorby (1979) observed that under adequate nitrogen supply, cells elongate extensively along the main axis leading to more growth of internodes and increase the length of stem their by increased kernel yield. Similar result of taller plant and higher grain yield at higher nitrogen levels was also reported by Ayub *et al*. (2013), Maryam Jasem *et al.* (2013) and Sreerekha *et al.*(2015).

Interaction effect between sowing windows and nitrogen levels was found to be non significant on growth and yield of preceding maize.

Effect of sowing windows and N levels on chickpea

Plant height at different growth stages and grain yield of succeeding chickpea was significantly influenced by sowing windows and nitrogen levels applied to preceding maize and nitrogen levels applied to succeeding chickpea during both the years of study (Table. 2). Significantly more taller plants and more grain yield of chickpea were registered when the preceding maize was sown in the 1st FN of July with 200 % RDN followed by 100 % RDN to chickpea. Sowing in the maize in the first FN of July facilitated to harvest by October 2nd fort night. Hence the succeeding chickpea was sown in time. The favourable climatic at the time of sowing chickpea helped rapid germination, good crop stand with rapid growth of the succeeding chickpea. Appling 200 % RDN to preceding maize with high residual available nitrogen and the nitrogen doses applied to chickpea might have favoured the growth of chickpea and hence the taller plants resulted in more grain yield of chickpea sown in second fortnight of October with higher nitrogen levels was also reported by Iqbaltak *et al.* (2010), Alinamvar *et al.* (2013) and Rehman *et al* . (2015)

Interaction effect between sowing windows and nitrogen levels of preceding maize and nitrogen levels applied to succeeding chickpea was found to be non significant on growth and yield of succeeding chickpea.

Conclusions

Sowing maize during 1st FN of July with 200 % RDN followed at 100 % RDN to succeeding chickpea was found to be the best in terms of growth and yield of maize-chickpea sequence

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